GASTRO-INTESTINAL HELMINTHS OF KANSAS COYOTES

by

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INTRODUCTION

The coyote, Canis latrans Say, is perhaps the most common predator of domestic and wild animals in the state of Kansas. The feeding habits of the coyote cause it to ingest larval parasites which on maturing may be the source of infection to both wild and domestic animals and man.

The purpose of this investigation was to determine the nature and incidence of the gastro-intestinal helminths of the coyotes. This investigation was made in conjunction with other studies on the coyote carried on in the zoology laboratories of Kansas State College by Dr. D. J. Ameel, Dr. H. T. Gier, and Dr. O. W. Tiemeier. The coyotes examined were received from trappers and hunters from 44 counties in the state of Kansas as indicated in Fig. 1. These coyotes were received only during the cool months of the year. They were either brought to the laboratory or shipped by express. During this period 424 coyotes were received.

MATERIAL AND METHODS

The stomach, small and large intestines were dissected from each coyote and the mesentery and omenta were removed. An incision was made with a pair of scissors from the cardiac to the pyloric ends of the stomach along the greater curvature, after which the stomach contents were searched and the worms

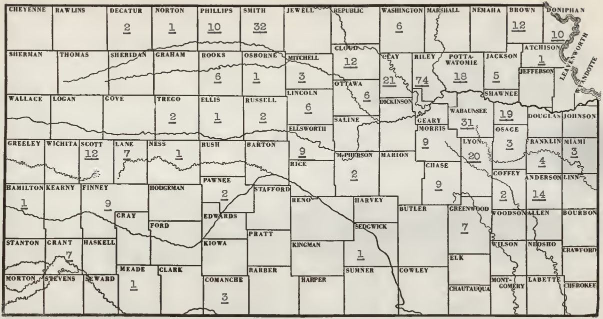

Fig. 1. Map of Kansas indicating areas from which coyotes were collected: numerals indicate the number of coyotes received from each county.

removed by forceps. To remove the helminths from the intestines, the flushing method of Ackert and Wolf (1929) was adapted. The intestinal contents which were removed readily by faucet water under pressure were flushed into a large jar and after several decantings the residue was placed in a photographic pan. The worms from the respective habitats were recovered and placed in vials containing 10 per cent formalin or 70 per cent alcohol. Following this procedure the vials were labeled with the specimen number of the coyote and the location from which the parasites were taken. The parasites were later cleared in lactophenol, identified and recorded.

INCIDENCE OF GASTRO-INTESTINAL HELMINTHS IN THE COYOTES OF KANSAS

A total of 17,839 helminth parasites was found in the 407 coyotes examined and recorded. The parasites comprised the ascarids, *Toxocara canis* Werner, and *Toxascaris leonina* von Linstow; the stomachworms, *Physaloptera rara* Hall and Wigdor and *Physaloptera praeputialis* von Linstow; the tapeworms, *Taenia pisiformis* Bloch and *Dipylidium caninum* Linnaeus; the hookworm, *Ancylostoma caninum* Ercolani. Of the 407 coyotes, 13 were entirely free of helminths, leaving 394 or 96.8 per cent of the coyotes showing infections of one or more of the above species in the gastro-intestinal tract. The number of parasites in the individual coyotes ranged from 1 to 519. Those coyotes having parasites in the stomach numbered 193, constituting 47.4

per cent of the total number. Those showing infections of both the stomach and intestines numbered 179 comprising 43.1 per cent of the total. Those coyotes having parasites in the intestines numbered 383 or 97.2 per cent of the coyotes.

The analysis of the incidence of the helminth parasites according to species, number, and percentage of coyotes infected, location of parasites in the digestive tract, the number and percentage of parasites in relation to the total and the range in the number of the parasites in the individual coyotes will be considered.

The Ascarids, _Toxocara canis_ and _Toxascaris leonina_

The total infections of 30 _Toxocara canis_ occurred in 7 or 1.7 per cent of the coyotes examined. The number in the individual coyotes ranged from 1 to 12 and were found in the small intestine.

Toxascaris leonina, numbering 523, was found in 77 coyotes or 18.9 per cent of those examined. The individual infection varied from 1 to 45. The stomachs of 9 coyotes were infected with 13 _Toxascaris leonina_ ranging from 1 to 3 in the individual coyotes. This constituted 2.4 per cent of the total number of _Toxascaris leonina_.

The total infection of ascarids numbered 558 or 3.1 per cent of the overall infection of helminths. Specimens of _Toxascaris leonina_ constituted 94.6 per cent of the ascarid infections.

The Hookworm, Ancylostoma caninum

Ancylostoma caninum occurred in 60 or 14.7 per cent of the 407 coyotes examined. The number of hookworms in each coyote ranged from 1 to 63 and totaled 378 for the 407 coyotes. The parasites were found in the stomach and in the small intestines. The stomach of one coyote contained one hookworm. Ancylostoma caninum comprised 2.1 per cent of the total infection.

The Stomachworms, Physaloptera rara and Physaloptera praeputialis

Physaloptera rara, totaling 1,909, occurred in 254 of the 407 coyotes; they comprised infections of 62.4 per cent. The number of parasites ranged from 1 to 53. They were found in the stomach and small intestines, however they occurred more frequently in the stomach.

Coyotes showing helminth infections of the stomach numbered 193. This constituted 47.4 per cent of the coyotes examined. Of the 1,909 Physaloptera rara found in the digestive tract, 1,448 were taken from the stomach. These comprised 75.3 per cent of the total number of Physaloptera rara.

Twelve specimens, tentatively identified as Physaloptera praeputialis were found with Physaloptera rara in the stomachs of three coyotes. These infections in the three coyotes constituted 0.7 per cent of the 407 coyotes examined. Of the total number of Physaloptera, 1,921, 0.6 per cent was Physaloptera praeputialis.

The Tapeworms, Taenia pisiformis and Dipylidium caninum

The total infection of tapeworms numbered 14,982 comprising 84 per cent of the total helminth infection. The total infection of Taenia pisiformis numbered 14,980, ranging from 1 to 519 in the individual coyotes. Taenia pisiformis comprised 99.9 per cent of the total number of tapeworms present. All of the 14,980 tapeworms were found in the small intestine.

Two Dipylidium caninum were found in the small intestine of one coyote, comprising 0.01 per cent of the total infection of tapeworms.

Table 1 shows the number and distribution of the internal parasites found in each of the 424 coyotes examined.

Table 1. Incidence of helminth parasites in Kansas coyotes.

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
1	Stomach	0						
	S. intest.	129					129	
2	Stomach	0						
	S. intest.	87					85	2
3	Stomach	3				3		
	S. intest.	34					34	
4	Stomach	0						
	S. intest.	1					1	
5	Stomach	0						
	S. intest.	37					37	
6	Stomach	0						
	S. intest.	17					17	
7	Stomach	0						
	S. intest.	65					65	
8	Stomach	0						
	S. intest.	56	12	21			23	
9	Stomach	0						
	S. intest.	13					13	
10	Stomach	0						
	S. intest.	18					18	

Table 1 (cont.)

Coyote No.	Helminths Habitat	Helminths No.	Species and number of helminths found: Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
11	Stomach	0						
	S. intest.	16					16	
12	Stomach	0						
	S. intest.	19		6			13	
13	Stomach	0						
	S. intest.	27				3	24	
14	Stomach	40				40		
	S. intest.	29			1	2	26	
15	Stomach	0						
	S. intest.	31					31	
16	Stomach	0						
	S. intest.	15					15	
17	Stomach	0						
	S. intest.	12				12		
18	Stomach	0						
	S. intest.	70					70	
19	Stomach	6				6		
	S. intest.	8					8	
20	Stomach	2				2		
	S. intest.	31					31	

Table 1 (cont.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
21	Stomach	0						
	S. intest.	0	(no record)					
22	Stomach	1				1		
	S. intest.	5					5	
23	Stomach	0						
	S. intest.	0	(no record)					
24	Stomach	0						
	S. intest.	41					41	
25	Stomach	0						
	S. intest.	150					150	
26	Stomach	0						
	S. intest.	6					6	
27	Stomach	0						
	S. intest.	49					49	
28	Stomach	3				3		
	S. intest.	90					90	
29	Stomach	0						
	S. intest.	46					46	
30	Stomach	0						
	S. intest.	17					17	

Table 1 (cont.)

Coyote no.	Helminths Habitat	No.	Species and number of helminths found Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
31	Stomach	0						
	S. intest.	12		8			4	
32	Stomach	0						
	S. intest.	1					1	
33	Stomach	0						
	S. intest.	94					94	
34	Stomach	0						
	S. intest.	10					10	
35	Stomach	0						
	S. intest.	300				1	299	
36	Stomach	0						
	S. intest.	183					183	
37	Stomach	0						
	S. intest.	6					6	
38	Stomach	0						
	S. intest.	75				1	74	
39	Stomach	0						
	S. intest.	16		7			9	
40	Stomach	0						
	S. intest.	30					30	

Table 1 (cont.)

Coyote No.	Helminths Habitat	Helminths No.	Species and number of helminths found: Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
41	Stomach	0						
	S. intest.	62				2	60	
42	Stomach	7				7		
	S. intest.	6					6	
43	Stomach	0						
	S. intest.	16					16	
44	Stomach	0						
	S. intest.	1				1		
45	Stomach	0						
	S. intest.	155					155	
46	Stomach	0						
	S. intest.	154					154	
47	Stomach	0						
	S. intest.	58					58	
48	Stomach	0						
	S. intest.	0						
49	Stomach	0						
	S. intest.	83					83	
50	Stomach	0						
	S. intest.	0						

Table 1 (cont.)

Coyote no.	Helminths: Habitat	Helminths: No.	Species and number of helminths found: Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
51	Stomach	0						
	S. intest.	31					31	
52	Stomach	0						
	S. intest.	12					12	
53	Stomach	0						
	S. intest.	24					24	
54	Stomach	0						
	S. intest.	0	(no record)					
55	Stomach	0						
	S. intest.	0	(not examined)					
56	Stomach	0						
	S. intest.	0	(not examined)					
57	Stomach	3				3		
	S. intest.	0						
58	Stomach	0						
	S. intest.	83					83	
59	Stomach	0						
	S. intest.	56					56	
60	Stomach	0						
	S. intest.	19					19	

Table 1 (cont.)

Coyote no.	Helminths Habitat	 No.	Species and number of helminths found Toxocara canis	 Toxascaris leonina	 Ancylostoma caninum	 Physaloptera rara*	 Taenia pisiformis	 Dipylidium caninum
61	Stomach	0						
	S. intest.	65					65	
62	Stomach	0						
	S. intest.	20					20	
63	Stomach	0						
	S. intest.	0						
64	Stomach	0						
	S. intest.	5		2		2	1	
65	Stomach	0						
	S. intest.	107		6			101	
66	Stomach	0						
	S. intest.	2					2	
67	Stomach	0						
	S. intest.	5					5	
68	Stomach	0						
	S. intest.	23					23	
69	Stomach	4				4		
	S. intest.	7					7	
70	Stomach	1				1		
	S. intest.	0 (not examined)						

Table 1 (cont.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
71	Stomach	3				3		
	S. intest.	0	(not examined)					
72	Stomach	0						
	S. intest.	4					4	
73	Stomach	4				4		
	S. intest.	0	(not examined)					
74	Stomach	0						
	S. intest.	0	(not examined)					
75	Stomach	6				6		
	S. intest.	48			2	5	41	
76	Stomach	0						
	S. intest.	25					25	
77	Stomach	0						
	S. intest.	111					111	
78	Stomach	3				3		
	S. intest.	200			6	3	191	
79	Stomach	0						
	S. intest.	18					18	
80	Stomach	0						
	S. intest.	0						

Table 1 (cont.)

Coyote no.	Helminths: Habitat	Helminths: No.	Species and number of helminths found: Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
81	Stomach	0						
	S. intest.	26				1	25	
82	Stomach	3				3		
	S. intest.	13					13	
83	Stomach	3				3		
	S. intest.	5					5	
84	Stomach	0						
	S. intest.	25		5			20	
85	Stomach	4				4		
	S. intest.	9		2			7	
86	Stomach	4				4		
	S. intest.	29					29	
87	Stomach	0						
	S. intest.	0	(disintegrated)					
88	Stomach	0						
	S. intest.	9					9	
89	Stomach	0						
	S. intest.	6					6	
90	Stomach	0						
	S. intest.	4					4	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
91	Stomach	0						
	S. intest.	99					99	
92	Stomach	0						
	S. intest.	71				2	69	
93	Stomach	0						
	S. intest.	33					33	
94	Stomach	0						
	S. intest.	29		1		2	26	
95	Stomach	0						
	S. intest.	0						
96	Stomach	0						
	S. intest.	42					42	
97	Stomach	7		1		6		
	S. intest.	21		1		2	18	
98	Stomach	14				14		
	S. intest.	69				1	68	
99	Stomach	8				8		
	S. intest.	28		1			27	
100	Stomach	0						
	S. intest.	35			1	2	32	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
101	Stomach	16				16		
	S. intest.	35					35	
102	Stomach	4				4		
	S. intest.	4					4	
103	Stomach	3				3		
	S. intest.	16					16	
104	Stomach	0						
	S. intest.	0						
105	Stomach	0						
	S. intest.	0	(not examined)					
106	Stomach	0						
	S. intest.	73			1		72	
107	Stomach	0						
	S. intest.	7					7	
108	Stomach	0						
	S. intest.	167			4		163	
109	Stomach	0						
	S. intest.	3					3	
110	Stomach	2				2		
	S. intest.	3					3	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
111	Stomach	0						
	S. intest.	25					25	
112	Stomach	6				6		
	S. intest.	21				5	16	
113	Stomach	7				7		
	S. intest.	13				7	6	
114	Stomach	0						
	S. intest.	0						
115	Stomach	0						
	S. intest.	23		9		2	12	
116	Stomach	0						
	S. intest.	27	7	16		1	3	
117	Stomach	0						
	S. intest.	123		5			118	
118	Stomach	0						
	S. intest.	42		31		1	10	
119	Stomach	0						
	S. intest.	7		7				
120	Stomach	2				2		
	S. intest.	13		2			11	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
121	Stomach	1				1		
	S. intest.	25		9		3	13	
122	Stomach	0						
	S. intest.	5		5				
123	Stomach	0						
	S. intest.	22	3	6			13	
124	Stomach	4				4		
	S. intest.	2		2				
125	Stomach	0						
	S. intest.	101	1	27		5	67	
126	Stomach	5				5		
	S. intest.	7				1	6	
127	Stomach	16				16		
	S. intest.	62					62	
128	Stomach	5				5		
	S. intest.	23		10			13	
129	Stomach	0						
	S. intest.	0						
130	Stomach	21				21		
	S. intest.	6					6	

Table 1 (cont.)

Coyote no.	Helminths Habitat	 No.	Species and number of helminths found Toxacara canis	 Toxascaris leonina	 Ancylostoma caninum	 Physaloptera rara*	 Taenia pisiformis	 Dipylidium caninum
131	Stomach	6				6		
	S. intest.	2					2	
132	Stomach	0						
	S. intest.	36		9			27	
133	Stomach	0						
	S. intest.	13				13		
134	Stomach	0						
	S. intest.	0						
135	Stomach	0						
	S. intest.	13					13	
136	Stomach	0						
	S. intest.	4					4	
137	Stomach	0						
	S. intest.	12	5	6		1		
138	Stomach	25				25		
	S. intest.	19					19	
139	Stomach	0						
	S. intest.	12					12	
140	Stomach	0						
	S. intest.	52		45		7		

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
141	Stomach	0						
	S. intest.	5		1		1	3	
142	Stomach	1				1		
	S. intest.	11					11	
143	Stomach	9		1		8		
	S. intest.	12					12	
144	Stomach	14				14		
	S. intest.	17					17	
145	Stomach	0						
	S. intest.	16		2	1	1	12	
146	Stomach	2		2				
	S. intest.	14		14				
147	Stomach	11		2		9		
	S. intest.	21		21				
148	Stomach	0						
	S. intest.	15			3	3	9	
149	Stomach	7		1		6		
	S. intest.	0						
150	Stomach	1				1		
	S. intest.	0						

Table 1 (cont.)

Coyote no.	Helminths: Habitat	Helminths: No.	Species and number of helminths found: Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
151	Stomach	0						
	S. intest.	1					1	
152	Stomach	0						
	S. intest.	5					5	
153	Stomach	0						
	S. intest.	2					2	
154	Stomach	6				6		
	S. intest.	15		12			3	
155	Stomach	0						
	S. intest.	1					1	
156	Stomach	18				18		
	S. intest.	50					50	
157	Stomach	0						
	S. intest.	0						
158	Stomach	0						
	S. intest.	0						
159	Stomach	15		1		14		
	S. intest.	0						
160	Stomach	0						
	S. intest.	77		6		1	70	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara?	Taenia pisiformis	Dipylidium caninum
161	Stomach	0						
	S. intest.	31					31	
162	Stomach	0						
	S. intest.	1					1	
163	Stomach	0						
	S. intest.	52					52	
164	Stomach	0						
	S. intest.	63					63	
165	Stomach	0						
	S. intest.	2				2		
166	Stomach	3				3		
	S. intest.	522		1	2		519	
167	Stomach	0						
	S. intest.	5					5	
168	Stomach	0						
	S. intest.	21					21	
169	Stomach	2				2		
	S. intest.	12					12	
170	Stomach	3				3		
	S. intest.	9					9	

Table 1 (cont.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
171	Stomach	3				3		
	S. intest.	184		2	2	1	179	
172	Stomach	0						
	S. intest.	32					32	
173	Stomach	0						
	S. intest.	24					24	
174	Stomach	0						
	S. intest.	21			12	6	3	
175	Stomach	0						
	S. intest.	9				1	8	
176	Stomach	0						
	S. intest.	22				1	21	
177	Stomach	0						
	S. intest.	6					6	
178	Stomach	0						
	S. intest.	45				10	35	
179	Stomach	3				3		
	S. intest.	0						
180	Stomach	4		1		3		
	S. intest.	38		14			24	

Table 1 (cont.)

Coyote no.	Helminths Habitat	 No.	Species and number of helminths found Toxocara canis	 Toxascaris leonina	 Ancylostoma caninum	 Physaloptera rara*	 Taenia pisiformis	 Dipylidium caninum
181	Stomach	6				6		
	S. intest.	79					79	
182	Stomach	0						
	S. intest.	182					182	
183	Stomach	0						
	S. intest.	0	(not examined)					
184	Stomach	0						
	S. intest.	6					6	
185	Stomach	0						
	S. intest.	10				2	8	
186	Stomach	0						
	S. intest.	0						
187	Stomach	0						
	S. intest.	36					36	
188	Stomach	0						
	S. intest.	11					11	
189	Stomach	0						
	S. intest.	20					20	
190	Stomach	0						
	S. intest.	10					10	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
191	Stomach	1				1		
	S. intest.	11					11	
192	Stomach	2				2		
	S. intest.	1					1	
193	Stomach	8				8		
	S. intest.	1					1	
194	Stomach	0						
	S. intest.	3			1		2	
195	Stomach	3				3		
	S. intest.	0						
196	Stomach	0						
	S. intest.	0						
197	Stomach	22				22		
	S. intest.	166			4	1	161	
198	Stomach	0						
	S. intest.	20				1	19	
199	Stomach	0						
	S. intest.	0 (not examined)						
200	Stomach	9				9		
	S. intest.	0 (not examined)						

Table 1 (cont.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
201	Stomach	0						
	S. intest.	15			1		14	
202	Stomach	38				38		
	S. intest.	46					46	
203	Stomach	7				7		
	S. intest.	35					35	
204	Stomach	4				4		
	S. intest.	0						
205	Stomach	0						
	S. intest.	12			1	10	1	
206	Stomach	0						
	S. intest.	14					14	
207	Stomach	53				53		
	S. intest.	22			16		6	
208	Stomach	0						
	S. intest.	7			1		6	
209	Stomach	0						
	S. intest.	10		3	1		6	
210	Stomach	0						
	S. intest.	81				1	80	

Table 1 (cont.)

Helminths			Species and number of helminths found					
Coyote no.	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
211	Stomach	0						
	S. intest.	30			3		27	
212	Stomach	0						
	S. intest.	50					50	
213	Stomach	3				3		
	S. intest.	18					18	
214	Stomach	0						
	S. intest.	30					30	
215	Stomach	0						
	S. intest.	76				2	74	
216	Stomach	2				2		
	S. intest.	16		1			15	
217	Stomach	0						
	S. intest.	34		17			17	
218	Stomach	0						
	S. intest.	71		1		2	68	
219	Stomach	18				18		
	S. intest.	100				5	95	
220	Stomach	18				18		
	S. intest.	0						

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
221	Stomach	6				6		
	S. intest.	26		1		8	17	
222	Stomach	3				3		
	S. intest.	1		1				
223	Stomach	0						
	S. intest.	34					34	
224	Stomach	0						
	S. intest.	30					30	
225	Stomach	6				6		
	S. intest.	58			15		43	
226	Stomach	0						
	S. intest.	8				3	5	
227	Stomach	0						
	S. intest.	65		4	2	3	56	
228	Stomach	2			1	1		
	S. intest.	35				7	28	
229	Stomach	0						
	S. intest.	29					29	
230	Stomach	0						
	S. intest.	14					14	

Table 1 (cont.)

Coyote no.	Helminths: Habitat	Helminths: No.	Species and number of helminths found: Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
231	Stomach	7				7		
	S. intest.	2					2	
232	Stomach	11				11		
	S. intest.	19			13	6		
233	Stomach	0						
	S. intest.	141				7	134	
234	Stomach	9				9		
	S. intest.	2				2		
235	Stomach	0						
	S. intest.	8				1	1	
236	Stomach	0						
	S. intest.	21			1		20	
237	Stomach	8				8		
	S. intest.	70		7	63			
238	Stomach	4				4		
	S. intest.	259					259	
239	Stomach	6				6		
	S. intest.	18					18	
240	Stomach	0						
	S. intest.	16					16	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
241	Stomach	4				4		
	S. intest.	24					24	
242	Stomach	2				2		
	S. intest.	127				1	126	
243	Stomach	27				27		
	S. intest.	63		8			55	
244	Stomach	52				52		
	S. intest.	17				1	16	
245	Stomach	0						
	S. intest.	93				2	91	
246	Stomach	0						
	S. intest.	253				19	234	
247	Stomach	0						
	S. intest.	49			1		48	
248	Stomach	0						
	S. intest.	66	1	4	1	2	58	
249	Stomach	0						
	S. intest.	5			5			
250	Stomach	0						
	S. intest.	1			1			

Table 1 (cont.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
251	Stomach	0						
	S. intest.	73				6	67	
252	Stomach	0						
	S. intest.	44			1		43	
253	Stomach	4				4		
	S. intest.	48				3	45	
254	Stomach	0						
	S. intest.	4					4	
255	Stomach	0						
	S. intest.	67				2	65	
256	Stomach	0						
	S. intest.	259					259	
257	Stomach	0						
	S. intest.	190		13	7		170	
258	Stomach	0						
	S. intest.	193					193	
259	Stomach	3				3		
	S. intest.	14					14	
260	Stomach	19				19		
	S. intest.	10					10	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
261	Stomach	0						
	S. intest.	28				3	25	
262	Stomach	9				9		
	S. intest.	171				4	167	
263	Stomach	5				5		
	S. intest.	41					41	
264	Stomach	0						
	S. intest.	155			1		154	
265	Stomach	0						
	S. intest.	7				2	5	
266	Stomach	5				5		
	S. intest.	202	1		9		192	
267	Stomach	5				5		
	S. intest.	227				1	226	
268	Stomach	0						
	S. intest.	37				2	35	
269	Stomach	12				12		
	S. intest.	34		3	1	1	29	
270	Stomach	10				10		
	S. intest.	77					77	

Table 1 (cont.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
271	Stomach	3				3		
	S. intest.	34					34	
272	Stomach	8				8		
	S. intest.	1					1	
273	Stomach	4				4		
	S. intest.	37					37	
274	Stomach	9				9		
	S. intest.	318				1	317	
275	Stomach	16				16		
	S. intest.	14				1	13	
276	Stomach	0						
	S. intest.	9					9	
277	Stomach	3				3		
	S. intest.	26				2	24	
278	Stomach	14				14		
	S. intest.	9		1			8	
279	Stomach	7				7		
	S. intest.	1		1				
280	Stomach	11				11		
	S. intest.	45			34	4	7	

Table 1 (cont.)

Coyote no.	Helminths Habitat	No.	Species and number of helminths found Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
281	Stomach	0						
	S. intest.	19		15		1	3	
282	Stomach	10				10		
	S. intest.	6				1	5	
283	Stomach	2				2		
	S. intest.	19					19	
284	Stomach	0						
	S. intest.	86		22	1		63	
285	Stomach	15				15		
	S. intest.	11				1	10	
286	Stomach	2				2		
	S. intest.	7					7	
287	Stomach	6		1		5		
	S. intest.	20				1	19	
288	Stomach	16				16		
	S. intest.	11		1			10	
289	Stomach	0						
	S. intest.	27		3			24	
290	Stomach	0						
	S. intest.	51				6	45	

Table 1 (cont.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
291	Stomach	5				5		
	S. intest.	31			1	11	19	
292	Stomach	1				1		
	S. intest.	72				2	70	
293	Stomach	2				2		
	S. intest.	138					138	
294	Stomach	2				2		
	S. intest.	158					158	
295	Stomach	9				9		
	S. intest.	16					16	
296	Stomach	6				6		
	S. intest.	35		1		2	32	
297	Stomach	5				5		
	S. intest.	35				1	34	
298	Stomach	10				10		
	S. intest.	21				5	16	
299	Stomach	5				5		
	S. intest.	14				1	13	
300	Stomach	1				1		
	S. intest.	17					17	

Table 1 (cont.)

Coyote no.	Helminths: Habitat	Helminths: No.	Species and number of helminths found: Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
301	Stomach	7				7		
	S. intest.	72					72	
302	Stomach	15				15		
	S. intest.	33		2			31	
303	Stomach	2				2		
	S. intest.	17					17	
304	Stomach	2				2		
	S. intest.	8					8	
305	Stomach	4				4		
	S. intest.	9					9	
306	Stomach	3				3		
	S. intest.	55					55	
307	Stomach	3				3		
	S. intest.	10					10	
308	Stomach	3				3		
	S. intest.	60				6	54	
309	Stomach	0						
	S. intest.	8				4	4	
310	Stomach	0						
	S. intest.	34				2	32	

Table 1 (cont.)

Coyote no.	Helminths Habitat	No.	Species and number of helminths found Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
311	Stomach	0						
	S. intest.	22					22	
312	Stomach	0						
	S. intest.	4				3	1	
313	Stomach	17				17		
	S. intest.	18					18	
314	Stomach	4				4		
	S. intest.	1					1	
315	Stomach	0						
	S. intest.	8					8	
316	Stomach	0						
	S. intest.	241					241	
317	Stomach	2				2		
	S. intest.	13				2	11	
318	Stomach	2				2		
	S. intest.	7				1	6	
319	Stomach	1				1		
	S. intest.	265			1		264	
320	Stomach	40				40		
	S. intest.	23				7	16	

Table 1 (cont.)

Coyote No.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara?	Taenia pisiformis	Dipylidium caninum
321	Stomach	6				6		
	S. intest.	62		1		1	60	
322	Stomach	4				4		
	S. intest.	6				3	3	
323	Stomach	0						
	S. intest.	5				5		
324	Stomach	2				2		
	S. intest.	4				2	2	
325	Stomach	4				4		
	S. intest.	55			4		51	
326	Stomach	3				3		
	S. intest.	26				4	22	
327	Stomach	1				1		
	S. intest.	3				3		
328	Stomach	0						
	S. intest.	23					23	
329	Stomach	5				5		
	S. intest.	10				6	4	
330	Stomach	0						
	S. intest.	4					4	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
331	Stomach	10				10		
	S. intest.	55				2	53	
332	Stomach	0						
	S. intest.	44		1	1		42	
333	Stomach	0						
	S. intest.	57				2	55	
334	Stomach	2				2		
	S. intest.	0						
335	Stomach	5				5		
	S. intest.	3					3	
336	Stomach	12				12		
	S. intest.	11					11	
337	Stomach	2				2		
	S. intest.	28				12	16	
338	Stomach	0						
	S. intest.	16				5	11	
339	Stomach	0						
	S. intest.	5					5	
340	Stomach	0						
	S. intest.	32				2	30	

Table 1 (cont.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
341	Stomach	0						
	S. intest.	14				13	1	
342	Stomach	0						
	S. intest.	19				3	16	
343	Stomach	4				4		
	S. intest.	6				1	5	
344	Stomach	0						
	S. intest.	8				2	6	
345	Stomach	3				3		
	S. intest.	5		1	1		3	
346	Stomach	0						
	S. intest.	16				2	14	
347	Stomach	5				5		
	S. intest.	79				2	77	
348	Stomach	9				9		
	S. intest.	12				3	9	
349	Stomach	11				11		
	S. intest.	111					111	
350	Stomach	13				13		
	S. intest.	175				2	173	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
351	Stomach	0						
	S. intest.	12					12	
352	Stomach	0						
	S. intest.	41				3	38	
353	Stomach	22				22		
	S. intest.	74			5	3	66	
354	Stomach	0						
	S. intest.	77		1		3	73	
355	Stomach	20				20		
	S. intest.	26			4	1	21	
356	Stomach	1				1		
	S. intest.	40					40	
357	Stomach	8				8		
	S. intest.	207			45	1	161	
358	Stomach	25				25		
	S. intest.	9				3	6	
359	Stomach	0						
	S. intest.	16					16	
360	Stomach	6				6		
	S. intest.	17				2	15	

Table 1 (cont.)

Coyote no.	Helminths Habitat	Helminths No.	Species and number of helminths found Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptora rara*	Taenia pisiformis	Dipylidium caninum
361	Stomach	1				1		
	S. intest.	4				3	1	
362	Stomach	9				9		
	S. intest.	2				2		
363	Stomach	9				9		
	S. intest.	6				1	5	
364	Stomach	11				11		
	S. intest.	9			2	5	2	
365	Stomach	6				6		
	S. intest.	22		3	1		18	
366	Stomach	3				3		
	S. intest.	0						
367	Stomach	5				5		
	S. intest.	93			1		92	
368	Stomach	3				3		
	S. intest.	48			9		39	
369	Stomach	0						
	S. intest.	12			3		9	
370	Stomach	0						
	S. intest.	101		3			98	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
371	Stomach	0						
	S. intest.	24					24	
372	Stomach	2				2		
	S. intest.	19					19	
373	Stomach	6				6		
	S. intest.	45		6	1		38	
374	Stomach	4		3		1		
	S. intest.	31		11		2	18	
375	Stomach	5				5		
	S. intest.	16				15	1	
376	Stomach	0						
	S. intest.	23					23	
377	Stomach	6				6		
	S. intest.	5		1		2	2	
378	Stomach	0						
	S. intest.	48					48	
379	Stomach	1				1		
	S. intest.	28		19	4	1	4	
380	Stomach	2				2		
	S. intest.	27				1	26	

Table 1 (cont.)

Coyote No.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
381	Stomach	0						
	S. intest.	64		1			63	
382	Stomach	4				4		
	S. intest.	11					11	
383	Stomach	23				23		
	S. intest.	5					5	
384	Stomach	8				8		
	S. intest.	19					19	
385	Stomach	6				6		
	S. intest.	126				1	125	
386	Stomach	0						
	S. intest.	41					41	
387	Stomach	1				1		
	S. intest.	6					6	
388	Stomach	1				1		
	S. intest.	7					7	
389	Stomach	3				3		
	S. intest.	11					11	
390	Stomach	6				6		
	S. intest.	36					36	

Table 1 (cont.)

Coyote no.	Helminths Habitat	Helminths No.	Species and number of helminths found Toxocara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
391	Stomach	3				3		
	S. intest.	102			23		79	
392	Stomach	6				6		
	S. intest.	5		2		1	2	
393	Stomach	10				10		
	S. intest.	22		2		3	17	
394	Stomach	3				3		
	S. intest.	27				1	26	
395	Stomach	0						
	S. intest.	9					9	
396	Stomach	3				3		
	S. intest.	8				7	1	
397	Stomach	0						
	S. intest.	108				6	102	
398	Stomach	27				27		
	S. intest.	36				2	34	
399	Stomach	12				12		
	S. intest.	17					17	
400	Stomach	1				1		
	S. intest.	7			1	2	4	

Table 1 (cont.)

Coyote no.	Helminths		Species and number of helminths found					
	Habitat	No.	Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
401	Stomach	17				17		
	S. intest.	68			9	6	53	
402	Stomach	9				9		
	S. intest.	6					6	
403	Stomach	4				4		
	S. intest.	11					11	
404	Stomach	0						
	S. intest.	23				2	21	
405	Stomach	6				6		
	S. intest.	19			11		8	
406	Stomach	5				5		
	S. intest.	71					71	
407	Stomach	4				4		
	S. intest.	25		1			24	
408	Stomach	1				1		
	S. intest.	178					178	
409	Stomach	1				1		
	S. intest.	11				4	7	
410	Stomach	3				3		
	S. intest.	8				7	1	

Table 1 (cont.)

Coyote no.	Helminths Habitat	No.	Species and number of helminths found Toxacara canis	Toxascaris leonina	Ancylostoma caninum	Physaloptera rara*	Taenia pisiformis	Dipylidium caninum
411	Stomach	4				4		
	S. intest.	53			2		51	
412	Stomach	8				8		
	S. intest.	1					1	
413	Stomach	1				1		
	S. intest.	0						
414	Stomach	0						
	S. intest.	12		8			4	
415	Stomach	0						
	S. intest.	27		11	11		5	
416	Stomach	0						
	S. intest.	5		5				
417	Stomach	0						
	S. intest.	33		7	11	1	14	
418	Stomach	0						
	S. intest.	20					20	
419	Stomach	0						
	S. intest.	6					6	
420	Stomach	0						
	S. intest.	65					65	

Table 1 (concl.)

	Helminths		Species and number of helminths found					
Coyote no.	Habitat	No.	*Toxocara canis*	*Toxascaris leonina*	*Ancylostoma caninum*	*Physaloptera rara**	*Taenia pisiformis*	*Dipylidium caninum*
421	Stomach	0						
	S. intest.	49			3	1	45	

(*) Six helminths from the stomach of coyote 147, five helminths from the stomach of coyote 237, and one specimen from the stomach of coyote 366 were tentatively identified as *Physaloptera praeputialis*.

DISCUSSION

The foregoing data bear out the fact that the seven species of helminth parasites, Toxocara canis, Toxascaris leonina, Ancylostoma caninum, Physaloptera rara, Physaloptera praeputialis, Taenia pisiformis, and Dipylidium caninum are capable of infecting the gastro-intestinal tract of coyotes.

Coyotes 1 to 196 were received from January 31, 1948, to April 11, 1948; those numbering 197 to 424 were received from December 13, 1948, to April 20, 1949. A higher incidence of the hookworm, Ancylostoma caninum, was noted in the group received from January 31, 1948, to April 11, 1948.

The commonest and most numerous parasite was the dog tapeworm, Taenia pisiformis; the next most prevalent parasite was the stomachworm, Physaloptera rara.

According to Morgan (1946) two different species of Physaloptera have never been reported from the same animal at the same time. This study indicated the occurrence of two species of Physaloptera in the stomachs of three coyotes. Three coyotes contained specimens of Physaloptera rara and other specimens tentatively identified as Physaloptera praeputialis.

Comparison of Toxocara canis (Werner, 1782) and Toxascaris leonina (Linstow, 1902)

Investigations indicate that three species of ascarids belonging to two genera occur in carnivores. In the genus

Toxocara, Toxocara canis is found in dogs and foxes and Toxocara cati is found in cats and foxes. In the other genus Toxascaris, Toxascaris leonina occurs in dogs, cats, foxes, and several wild felines.

These ascarids are not readily differentiated, especially as preserved specimens. Clearing or dissection of the body wall to expose the base of the oesophagus is required to determine whether the oesophagus terminates posteriorly in a ventriculus or histologically distinct ovoid bulb (Fig. 2) characteristic of the genus Toxocara, or whether such a bulb is lacking (Fig. 3) as in the genus, Toxascaris.

The absence of a ventriculus in a specimen collected from a coyote in this study establishes the diagnosis as T. leonina. The presence of a ventriculus indicates the genus Toxocara. The species is then determined by considering the nature of the cervical alae. If the latter are relatively long and narrow and taper gradually from the region of their greatest breadth to the point of their posterior termination, so that the cervical region has a lanceolate appearance, the specimen is T. canis (Fig. 2). If the alae are relatively short and wide and decrease abruptly in width from the region of their broadest extent to the point of their posterior termination, so that the cervical region when viewed ventrally, or dorsally, appears heart-shaped, or has the shape of a stone Indian arrow-head, the worm is T. cati.

Other useful recognition characters are: The nature of the

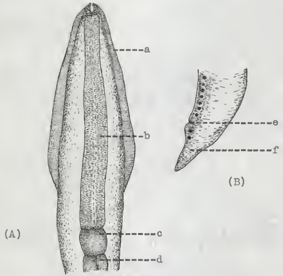

Fig. 2. Toxocara canis. (A) Dorsal view of the anterior extremity showing the termination of the muscular oesophagus with a distinct bulbous ventriculus. (B) Lateral view of the posterior extremity of a male indicating the nature of the "probular" end. (a) cervical alae; (b) oesophagus; (c) bulbous ventriculus; (d) intestine; (e) cloaca aperture; and (f) probular appendage.

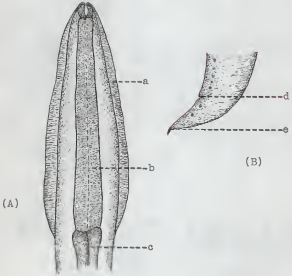

Fig. 3. Toxascaris leonina. (A) Dorsal view of the anterior extremity showing the termination of the muscular esophagus with the intestine. (B) Lateral view of the posterior extremity of a male indicating the nature of the conical end. (a) cervical alae; (b) esophagus; (c) intestine; (d) cloaca aperture; and (e) terminal spine.

outer layer of the egg shell in gravid females and the shape of the tail in males. Eggs of Toxocara have pitted surfaces whereas those of Toxascaris have smooth ones. In males of the latter genus, the tail is conical in shape (Fig. 3); in males of Toxocara, the tail diminishes abruptly in diameter a short distance behind the cloaca and therefore has been described as "probular".

These helminths, according to Hönnig (1947), inhabit the upper portion of the small intestine. The adult female ascarid after copulation with the male, lays thousands of single celled eggs which are then passed to the exterior in the feces of the host. Under suitable conditions, the eggs segment and develop into the coiled embryo or infective stage in three to five days. The embryos moult once in the egg shell, and after ingestion by the next host, hatch in the intestine and burrow into the mucosa of the intestine. They may enter the liver through the peritoneal cavity, but the usual mode of migration to this organ is by the blood stream. From the liver the larvae migrate to the lungs via the cardio-vascular system, enter the alveoli, develop and moult. After two or three weeks the larvae migrate to the respiratory passages thence to the pharynx and are passed down the oesophagus to the small intestine, where, in the normal host such as the coyote, they develop into adults in eight to nine weeks.

According to Wright (1935), in his experiments carried out with albino rats, mice, guinea pigs, and dogs, the larvae of

Toxascaris leonina do not regularly migrate throughout the body of the host. The liberated larvae penetrate the wall of the small intestine, especially that of the lower part of the duodenum, and come to rest in the crypts of Lieberkühn in the sub-mucosa and in the circular muscle of the wall. The larvae undergo considerable growth while in the intestinal wall and begin to emerge about the 9th or 10th day after infection. Following their re-entrance into the lumen of the small intestine, the larvae grow rapidly and by the 18th day of the infection undergo two ecdyses into the adult form.

The migratory habits of the ascarid larvae of Toxocara canis and Toxascaris leonina in the body of an accidental host may give rise to pathological conditions.

The eggs of Toxocara canis and Toxascaris leonina containing the coiled or infective larvae may be accidentally swallowed by man. Upon reaching the intestine, the eggs hatch and the larvae begin a harmful migration in the body of the accidental host. Although the development of the ascarid larvae in the accidental host is very rare, it has been substantiated by experiments of Danheim (1925) who recovered a number of cat ascarid larvae from the livers of rats after infecting them with eggs containing coiled embryos. Several cases of the cat ascarid infections in the human host have been recorded in Europe and North America (Leiper, 1907).

The pathological conditions caused by the larvae include minute lesions accompanied by petechial hemorrhages and possible infection by intestinal bacteria. These lesions are rarely severe enough to produce clinical symptoms. The larvae in heavy infections upon reaching the lungs may set up a verminous pneumonia characterized by chronic focal alveolar emphysema, atelectasia, ecchymotic hemorrhages, local eosinophilia and marked exudation.

Description and Pathogenesis of *Ancylostoma caninum*

The distribution of the dog hookworm, *Ancylostoma caninum*, in the canine species throughout the United States and the disease, ancylostomiasis, associated with the infection makes it a problem not only for the small animal practitioner but also the public health official since it is capable of infecting the human. Landsberg (1939) reporting on a survey made by Hinman in 1936 indicates that of 1,315 dogs examined in New Orleans, 41.5 per cent of the mature animals and 44.4 per cent of the immature ones were infected. This gives an idea of the incidence of this parasite in at least one section of this country.

This dog hookworm has been reported frequently in cats and in other carnivores. Ackert's findings in 1941 indicated the stomach as a new habitat for *Ancylostoma caninum* in the cat.

The hookworms belong to the family Strongylidae and are characterized by the presence of a bursa copulatrix on the posterior end of the male. It has a cream-colored cylindrical body with a finely striated chitinous cuticle. The worms have a wide buccal capsule provided with three teeth on each side of the aperture. The males range from 10 to 12 mm in length and 0.4 mm in width while the females range from 14 to 16 mm or more in length and 0.6 mm in width. The bursa which is large and flaring is supported by long slender rays.

The only positive evidence of an infection in an animal is the presence of the eggs in the feces. The size of the eggs according to Mönnig (1947) measures 56-65 by 37-43 microns and contain an embryo of about eight cells when laid.

The embryonated egg requires a favorable environment for further development. It develops best in a wet, light, sandy loam soil shaded with decaying vegetable matter. Under outdoor temperature variations, the eggs usually hatch in 24-48 hours. The larvae, feeding upon living bacteria, grow to almost twice their original length within 72 hours. They then undergo ecdysis shedding their cuticular covering and enter the second or infective stage of larval development. Growth continues for about four or five days at which time the larvae are about 0.5 to 0.7 mm in length (Landsberg, 1939). The infective larvae are unable to feed in the soil and depend upon their entrance into the final host to continue their development. This larval stage is known as the filariform or infective stage.

This filariform larvae under suitable conditions of temperature and moisture remain on the surface or upper layers of the soil. They are capable of climbing upon any protruding objects such as leaves, sticks, or soil particles, extending their bodies and commonly waving back and forth. As long as a moist atmosphere prevails the larvae remain on the surface of the soil. As dryness ensues, they migrate back into the soil.

The larvae are attracted by heat and exhibit thigmotropism. They may live in the soil about six weeks.

Infection of the final host, the dog or related carnivores, may occur in three ways. The larvae may penetrate the skin, may be ingested with food and water, or prenatal infection may occur. Mouth infection is probably the most common means of infection in the dog because of their food habits.

During skin penetration the cuticular sheath is lost if it has not already been lost in the soil (Cort, Augustine, Ackert, Payne and Payne, 1922) and the larvae find their way into the blood capillaries from where they are carried by the venous circulation to the right side of the heart and out through the pulmonary arteries into the lungs. From the lung capillaries, they burrow their way out into the alveoli, and migrate into the bronchioles, up the trachea, move down the oesophagus and finally become localized in the small intestine. During this stage of migration they undergo a third ecdysis which allows the worms to attach themselves to the gut mucosa.

When the infection occurs by mouth, the larvae do not undergo lung migration but develop directly in the intestine.

The most likely route of the larvae in prenatal infection is transportation from the maternal circulation to the fetus.

Foster (1932) pointed out that the development of the larvae is not initiated until the birth of the puppies and that the larvae remain in the organs until parturition.

The penetration of the skin produces a local reaction. Landsberg (1939) observed that young dogs showed no more than a transitory inflammation after larval penetration while in old animals a marked edema and inflammation occurred immediately and persisted for at least a week, with pronounced exudation and necrosis at the center of the lesion.

Petechial hemorrhages are found in the lungs as a result of the migratory journey of the larvae from the pulmonary capillaries into the air sacs.

The most extensive and serious morbidity from _A. caninum_ is produced by the attachment of the parasites to the mucosa of the intestine and the associated anemia. The worms maintain themselves in the intestine by grasping a portion of the mucous membrane with their powerful mouth parts. A portion of the mucosa is drawn into the buccal cavity and is torn away as the worms migrate from place to place in the intestine to feed (Wells, 1931). With the mucosa removed there remain small bleeding necrotic areas which may become foci of secondary bacterial infections.

The filariform larvae are infective to man. The pathogenic condition wrought from infection of _A. caninum_ is commonly called creeping eruptions. The infective larvae penetrate the epidermis and cause characteristic skin lesions which are evidenced by advancing tracks of thickened skin accompanied by pruritis. Transient dermatitis and papular skin lesions have been found to be due to the infection of the filariform larvae (Dove, 1932).

The Prevalence of the Tapeworm, *Taenia pisiformis*

The extremely large number of *Taenia pisiformis* found in the 407 coyotes examined can be accounted for by considering the food habits of this host. An examination of the stomach contents disclosed a considerable amount of rabbit remains.

The life cycle of *Taenia pisiformis* requires the rabbit as an intermediate host. Hares and rabbits are infected by swallowing the eggs or entire proglottids from the feces of dogs, foxes, or previously infected coyotes. In the duodenum the shell is dissolved and the oncospheres penetrate the intestinal wall, from where they are carried with the blood to the liver (Christensen and Roth, 1949). In the liver, the constantly growing larvae wander about, until they emerge into the peritoneal cavity, and three to four weeks after the infection they form, on the omentum or the mesentery, the typical pea-sized cysticerci, which are enclosed by a fibrous capsule developed by the host animal.

The coyotes become infected with tapeworms by consuming the measly organs from hares and rabbits. The cysticerci passing the entrance of the bile duct invaginate and the scolex attaches itself to the intestinal wall and undergoes sexual maturity.

SUMMARY

A study of the digestive tract of 407 coyotes was made to determine the incidence of helminth parasites in *Canis latrans*. The coyotes were obtained from hunters and trappers in 44 counties of Kansas.

The stomach, small and large intestine were removed in their entirety from the abdominal cavity. The mesentery and omenta were disposed of and an incision was made along the greater curvature of the stomach to expose the parasites.

The parasites found in the stomach and the intestinal tract of each individual coyote were placed in separate containers according to their location. These were then bottled in vials marked with the respective specimen number and habitat. The parasites were preserved in either 10 per cent formalin or 70 per cent alcohol and later cleared and identified.

A total of 17,839 parasites were found in the 407 coyotes examined. Of this number 30 were identified as *Toxocara canis*; 528, as *Toxascaris leonina*; 378, as *Ancylostoma caninum*; 1,909, as *Physaloptera rara*; 12, as *Physaloptera praeputialis*; 2, as *Dipylidium caninum* and 14,980, as *Taenia pisiformis*.

The average total infection per coyote numbered 43.5 parasites. Of this number 3.6 occurred in the stomach; and 39.9 in the small intestines. The average incidence for the six species in each coyote was as follows: *Toxocara canis*, 0.07; *Toxascaris leonina*, 1.3; *Ancylostoma caninum*, 0.9; *Physaloptera rara*, 4.6; *Taenia pisiformis*, 36.8; *Dipylidium caninum*, 2 (occurred in one coyote).

Of the 407 coyotes examined 394, or 96.8 per cent were infected with one or more of the six species mentioned. The number of parasites in each coyote ranged from 1 to 519.

Coyotes with an infection of *A. caninum* numbered 60. The appearance of one *A. caninum* in the stomach of one coyote was believed to be due to the wondering of the worm into the stomach from the intestine after the death of the host.

P. rara occurred in 254 coyotes, with 75.3 per cent of these parasites occurring in the stomachs of 193 coyotes. The high incidence of this nematode indicates that it is a regular parasite occurring in the digestive tract of coyotes.

Twelve specimens tentatively identified as *Physaloptera praeputialis* occurred in the stomachs of three coyotes.

This incidence of the genus *Physaloptera* was the highest of any of the four nematode genera found.

Taenia pisiformis was found in 361 coyotes. The aggregate of 14,980 tapeworms occurred in the small intestines.

Two specimens of *Dipylidium caninum* occurred in the small intestine of one coyote.

Toxocara canis occurred in 7 coyotes.

Toxascaris leonina was found in 77 coyotes.

The occurrence of *Ancylostoma caninum*, *Physaloptera rara*, *Physaloptera praeputialis*, *Toxocara canis*, *Toxascaris leonina*, *Taenia pisiformis*, and *Dipylidium caninum* in the gastrointestinal tract of coyotes serves as a possible source of larval infection in domestic and wild animals as well as man. None of the animals examined evidenced undue injury caused by the helminth parasites.

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